GIANT SAND POINT FOR A BUBBLE GAGE ORIFICE HOUSING

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GIANT SAND POINT FOR A BUBBLE GAGE ORIFICE HOUSING

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INTRODUCTION

An orifice housing was devised to solve problems encountered in the operation of a bubble gage water level indicator installed on a sand bed stream.

Obtaining water level records for sand bed streams is difficult with conventional float-operated water level recorders; sediment is deposited in the float well, which anchors the float, or in the intake, which reduces the responsiveness of the water level in the float well to water level changes in the stream. As a solution to these problems, the U.S. Geological Survey[3] developed a bubble gage servo-manometer to replace the well and the float. In this gage a mercury manometer senses the pressure in a tube carrying nitrogen gas which bubbles through an orifice located below the water surface. As the water level changes, so will the pressure in the gas feed system. Thus, the orifice must remain fixed in elevation since water levels are referred to its position. Also, the orifice must always be below water level but above the streambed. This may not be possible in a stream which scours and fills several feet, or in which the flow at times may be shallow. The solution is to place the orifice low enough so that it will be below the expected minimum water level and to provide a filter or screen around it so it will remain in free communication with the water though buried in sediment. A commercial sand point was tried, but it tended to fill with fine sand or silt, or if buried completely in sediment, it would not remain responsive to water level changes. At some locations, the streambed scoured completely below the sand point and dislodged it.

The threat to the stability of the orifice by channel scour can be solved by mounting the orifice on a stable bridge pier. Where no structure is available, some other means must be found for firmly anchoring the orifice.

The giant sand point was designed to provide firm anchorage independent of any other supporting structure, ample storage for any silt entering it, and screened openings for sediment exclusion and ready communication with the water. Also, a self-cleaning sand point was designed for attachment to a bridge pier.

FABRICATION OF THE SAND POINT

The giant sand point is a 4-inch, standard weight, galvanized pipe about 20 feet long with the bubble gage orifice placed in its side near the top. A vented cap is provided to minimize sediment entry into the pipe and yet permit escape of the nitrogen gas so pressure will not build up in the pipe. Ready communication of water levels in the stream and in the pipe is provided by a series of lengthwise slots in the pipe. The slots are covered with screen wire to hinder sediment entry. Details of the design and construction are shown on figure 1.

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[3] Bubble Gage (Water-Stage Servo-Manometer with Gas-Purge System), Installation and Service Manual; U.S. Geological Survey, Surface Water Branch, Research Section, Columbus, Ohio, October 1962. Processed.

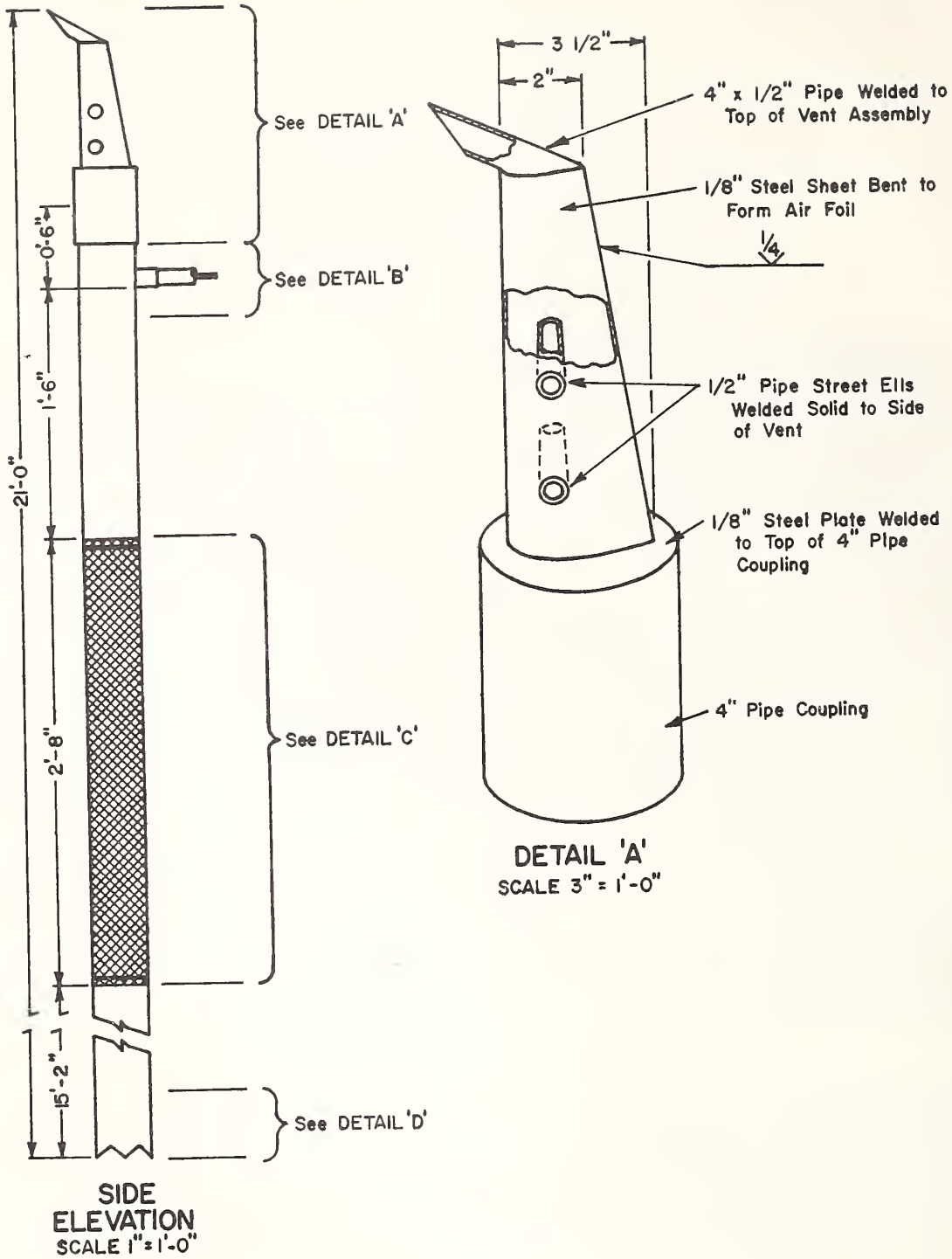

Figure 1.--Giant sand point with built-in silt trap and vent.

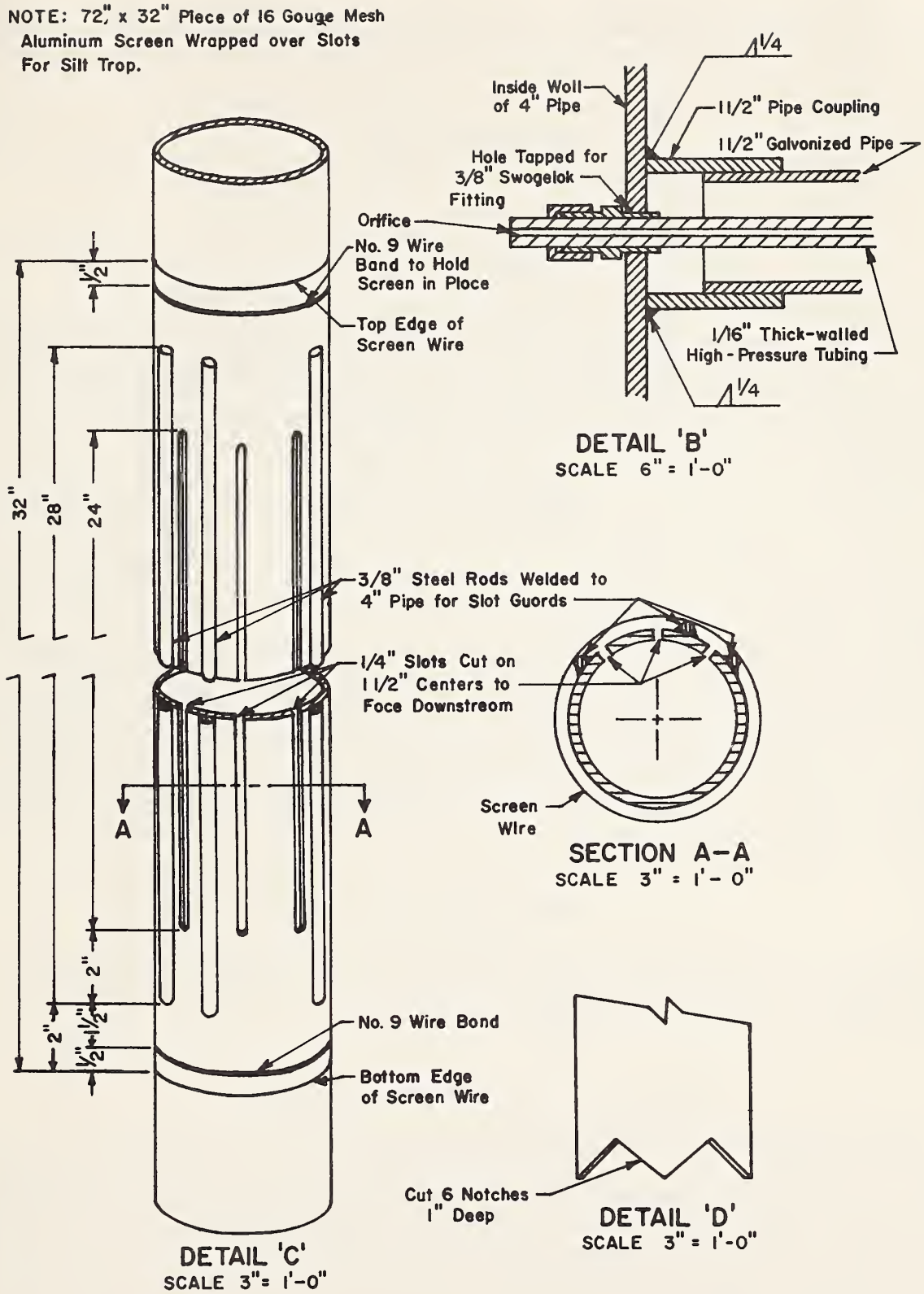

Figure 1.--Giant sand point with built-in silt trap and vent--continued.

The 20-foot length of pipe when driven or jetted into the streambed is sufficient to assure stability of the orifice. This length also provides ample storage for the sediment that enters the pipe during several runoff events. All steel in the assembly is galvanized to inhibit corrosion.

INSTALLATION

The sand point may be installed by:

1. Driving it into the streambed. A crane is required for this method.
2. Jetting it down in one piece. A bridge or other structure to which block and tackle can be attached is needed for this operation. Separate tackle are required for the sand point and the jet pipe because the jet pipe must be able to move independently.
3. Jetting it down in sections. The first section should be 10 feet long and the additional sections 5 feet or less. Couplings are needed for both the sand point and the jet pipe.

The jet pipe may be constructed of 1 1/2- or 1 1/4-inch pipe. The pump used in jetting should have a capacity of 250 gallons per minute at 15 pounds per square inch pressure.

The 4-inch pipe can be turned easily with a 36-inch chain wrench during installation. The sawtooth edge at the bottom end of the sand point assists in cutting through tree limbs, other buried objects, and layers of gravel.

Elevation of the orifice is determined by the anticipated minimum elevation of the channel bed. The orifice must be set low enough because the pipe is very difficult to lower or raise after the sand has settled around it. However, the vent assembly can be extended upward above the streambed by simply removing the vent assembly and adding a 4-inch coupling and nipple of the appropriate length to the top of the sand point. The vent assembly performs best when all openings are above the bed of the stream.

During low flows, a sand bed stream tends to meander and may move away from the sand point; thus, the orifice is rendered inoperative. The low water channel may be stabilized laterally to prevent this meandering by installing a series of low water jetties to keep water flowing over the sand point. Jetties have been constructed by jetting 10- to 14-foot lengths of angle iron into the stream bed and lacing them together with number 9 wire. One and one-eighth-inch mesh chicken wire, attached to the angle iron projections, catches enough debris to effectively deflect the low flow current. The tops of the low water jetties should be as low as possible; 1 foot above the channel bottom is usually sufficient.

MAINTENANCE

Maintenance of the sand point consists of periodically removing the top (vent assembly) and jetting the silt out of the trap. The equipment required is a portable pump and enough 1 1/2-inch smooth rubber hose to reach to the bottom of the silt trap.

THE SELF-CLEANING SAND POINT

A self-cleaning sand point which requires but little maintenance was developed for use where the following conditions can be met: (1) The availability of a structure, such as a bridge pier or piling, to which the sand point can be securely attached, and (2) the occurrence of considerable scouring of the channel during a flow. The scouring is essential because the sand point will be self-cleaning only when the channel bed scours below the open bottom. This leaves a clean silt trap at the start of the channel-filling process which usually occurs during the recession flow. The bridge pier, essential for the mounting of the sand point, is the place where the greatest amount of scouring usually occurs.

The self-cleaning sand point is similar to the giant sand point except for a simpler vent cap and a shorter pipe. The details of its design and construction are shown on figure 2.

Six giant sand points and one self-cleaning sand point performed well during 1965; no water level records were lost. Jetting easily removed any sediment that accumulated in a pipe. Pipes installed on tributaries filled with sediment at the rate of 1 foot for each 2 feet of rise of the stream. On the main stem, the ratio was 1 foot of silt to each 8 feet of rise. The length of pipe below the orifice, though determined chiefly by anchorage requirements, could be governed by the sediment storage requirements.

SUMMARY

The giant sand point provides free communication for the orifice of a bubble gage water level recorder with the water level in a sand bed stream. Without the special housing provided by a giant sand point, the orifice would not remain open in flows carrying tremendous sediment loads in shifting channels. The 20-foot length of 4-inch diameter pipe comprising the body of the sand point provides both firm anchorage for the orifice and ample storage for sediment. A cap on the pipe minimizes sediment entry and permits ready escape of the gas from the bubble gage.

Experience with seven sand points has been favorable. No water level records were lost during a year of operation and maintenance has been minimal.

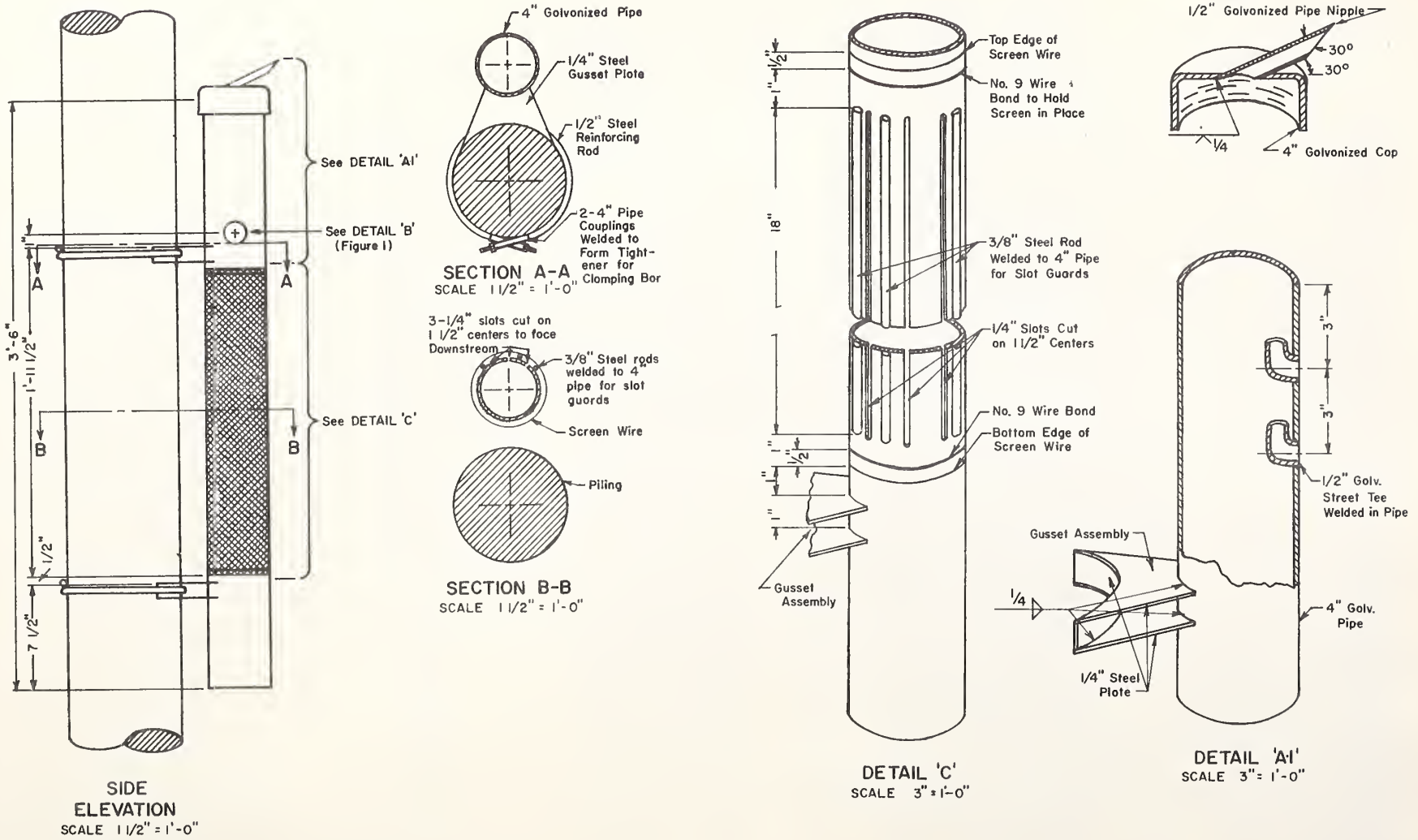

Figure 2.--Self-cleaning sand point for bubble gage orifice.